



## C2 REVEALING GOOD PRACTICE

# Constructing a hand-dug well

## At a glance

This tool gives guidance on constructing a hand-dug well.

- Identify the best site using a hydrogeological survey, considering also the community's preferences for location.
- Understand and follow legal requirements. Get permission where needed.
- If possible, drill or dig a test hole to check the quality of the water and the water table depth.
- Test the water volume (how much water there is) with the help of a hydrogeological engineer.
- Plan the design. Think about well depth and lining, and how to pump water out during construction.
- Ensure the well does not collapse and the well-head does not break during construction.
- Test the water quality, then commission and handover the well.
- Assist the community to develop a water safety plan to prevent water contamination. Ensure ongoing maintenance and testing – within the water safety plan.



## Why use this tool?

Access to clean water is necessary to ensure health, nutrition, education and livelihoods. In many places hand dug wells are a popular method for households to access groundwater. As the wells are dug by hand, the ground must be a suitable material, for example, clays, sands, gravels and mixed soils where there are no large boulders.



## A brief description

This tool gives guidance on choosing and constructing an appropriate type of well to access water (mainly for domestic use). It looks at location, how the well will be maintained and operated, the needs of those who use it, available materials, building techniques, important physical and environmental considerations, and the well construction method that is most appropriate in a given context.

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Conflict &amp; peace-building

Corruption &amp; governance

Disaster risk management

Discrimination &amp; inclusion

Food &amp; livelihoods

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Health &amp; HIV

Influencing decision-makers

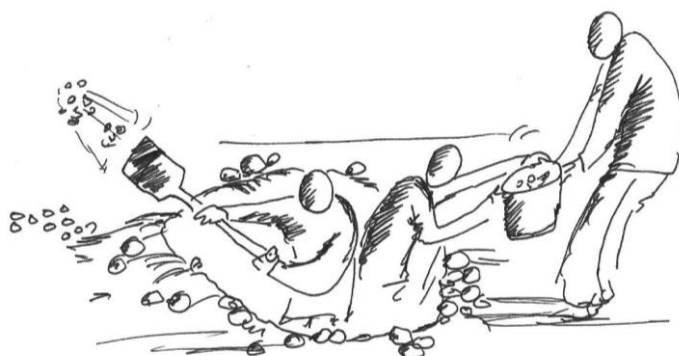
Migration &amp; trafficking

Water, sanitation &amp; hygiene

## C2 CONSTRUCTING A HAND-DUG WELL

Awareness-raising	Children & youth	Climate & environment	Conflict & peace-building	Corruption & governance	Disaster risk management	Discrimination & inclusion	Food & livelihoods	Gender & sexual violence	Health & HIV	Influencing decision-makers	Migration & trafficking	Water, sanitation & hygiene
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A well is a hole, shaft or excavation used to obtain water from underground. There are many different designs, the choice of which depends mainly on the stability of the soil and the distance to the water table. This tool focuses on hand dug wells, but explains where to get advice if a drilled well is required.



### Explaining the words we use

**Aquifer** – underground water source

**Contaminate** – causing water (in the well) to become dirty or “infected” through exposing it to faeces or other harmful substances.

**Well lining** – the inner walls of a well, which must be constructed to stop the well from collapsing in upon itself if the soil or rock is unstable, or where the well is prone to flooding.

**Water table** – the level of water, held within the soil or rocks below the ground surface. The water table usually rises in the rainy season, and falls in the dry season.

**Infiltrate** – the action of water or a liquid moving down through the soil layers, towards the water table.

**Well yield (or safe yield)** – the quantity of water that is removed from the well without the water level in the well reducing. In other words, it is the point at which the water removed from the well is equal to the amount of water entering the well.

**Open defecation** – the practice of defecating outside on the ground surface or in bodies of water, rather than in a toilet or latrine.



### Time taken

The actual construction of a hand-dug well often takes anywhere between three and 12 weeks, if all the materials are readily at hand. Of course, the length of the process is governed by the underground rock types, and how easy it is to dig!

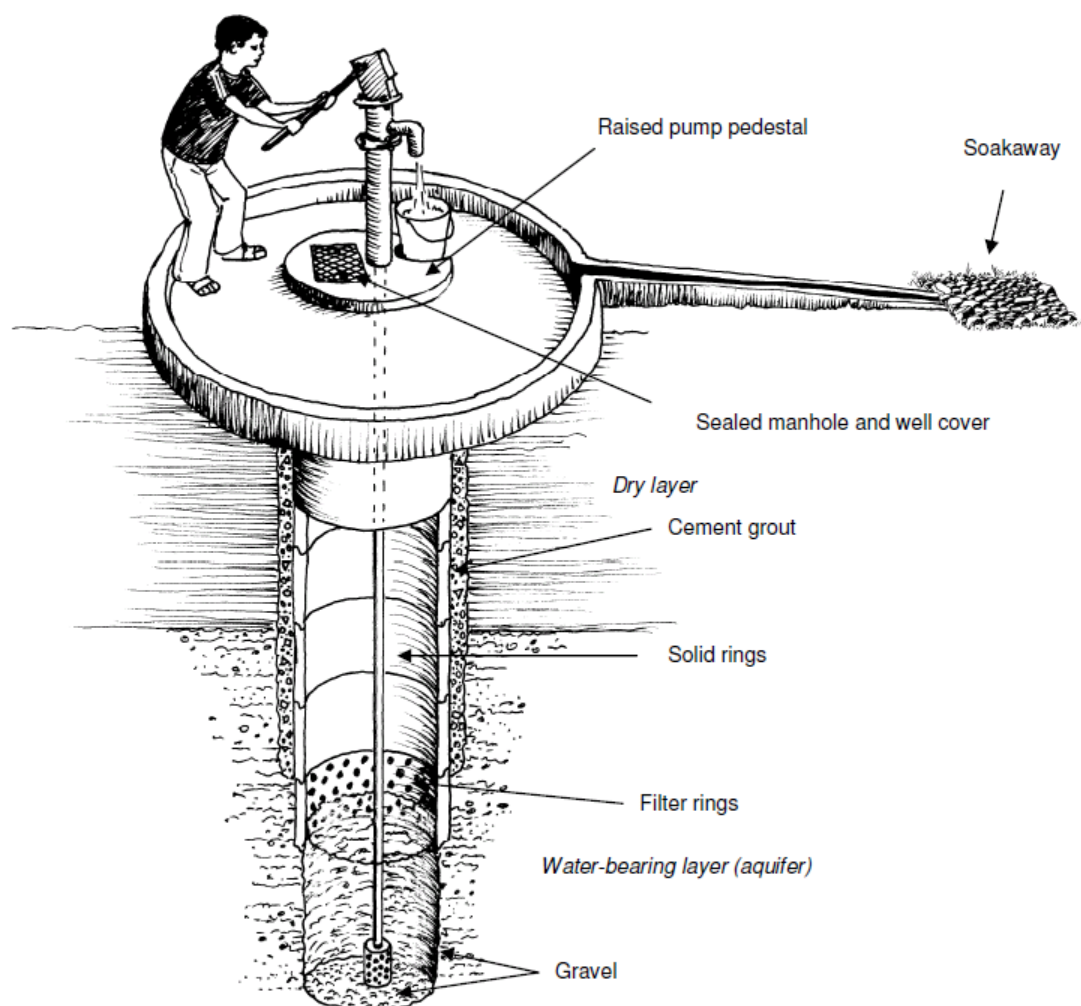
The process of design, consultation, siting, sourcing and buying of the materials, community training and general project preparation with the community may take several weeks beforehand.



### Keys to success

- Ensure the well is not located close to, or downhill from, sources of pollutants such as burial grounds, latrine pits, mines or petrol stations.
- Once the well is dug, check the water quality and yield before further construction. Before digging begins, consider yield and water quality from other wells in the area.
- Ensure all legal requirements are understood and followed and that you get permission where needed.
- Ensure participation: women and men from the community should be involved in the design, planning and construction of the well.
- Ensure that the well is designed and constructed so that it doesn't collapse, it doesn't get contaminated and it is easy to maintain.
- Once the well is constructed, encourage the community to develop a) a spare parts supply chain for the hand-pump, and b) a Water Safety Plan to keep water free from contamination and to plan for ongoing well maintenance.

### The different parts of a hand-dug well built using concrete ('caissons') rings





## What to do

### Understand the policy environment.

Start by finding out whether the national and/or local government has a policy or strategy for ensuring people in your area have access to safe and clean water. For example, there may be a national minimum standard of safe water quantity per person per day, or there may be a specific policy on payment or subscriptions for a community water supply. If this is the case, you may want to consider advocacy, calling on them to fulfil their responsibility, and seeing how you could work with them in the provision of water supply. See Section B1 for tools and guidance on advocacy, including **Tool C1 – Advocacy – communicating with people in power.**

### Ensure participation.

It is important to involve women and men from the community in the design, planning and construction of the well.

### Find the best location for the well.

Ideally, a proper hydrogeological survey should be carried out by a qualified engineer to ensure you have found a water source of sufficient quantity and quality. However, if no written or mapped data exists, or expertise is not available, consideration of the likelihood of obtaining the quantity and quality of the water required is critical, otherwise the work could be wasted. It is important to consider also the risk of flooding or environmental degradation, because this could influence the actual siting of the well, as well as its design.

It is also extremely important to consider the needs and desires of those who will be using the well - especially women. How easy will it be for them to access to the well? It is important to consider who owns the land that the well is on, and the access routes to the well.

Make sure that the well is located upstream of potential pollution sources such as pit latrines, petrol stations, rubbish pits or burial grounds. There are two main areas of consideration in terms of siting a well:

### Understand and obey legal requirements.

In most countries, you cannot just dig a well! You need permission from relevant authorities such as the Ministry of Water or Environment - this is often called an 'abstraction licence'. There are strict requirements that have to be met regarding the quality of water, the location of the well (who owns the land on which the well is sited?), quantities of water allowed to be pumped, and how close the well can be to other wells.

### Check the water quality.

Ground water is generally safe to drink, because the water is natural filtered as it moves through the soil. However, chemical contamination is possible, which is why the well should never be located downhill from, or close to, a chemical industry or a mine. National water quality standards are different for drinking water, irrigation water and water for commercial

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use. However, there are clear standards for each of them that you have to prove that you meet in most countries before you are allowed to use the water.

### Check the water quantity.

In most cases, a hydrogeological engineer will need to undertake well testing and an aquifer volume assessment, unless this has previously been done by a local authority engineer. This assessment is to make sure that the water the well produces will be enough to meet the demand (ie how much the well is used). It is important to ensure that people do not remove more water from the aquifer than is naturally replenished. Over-pumping can also cause salinization when close to salt water sources such as the sea. Over-pumping can also cause siltation which makes the water cloudy and can cause the pump to fail.

### Ensure the well is designed properly.

Wells usually have the following parts to them: a well screen or inlet that allows the water to enter the well, a pump, well casing (usually surrounded by a gravel pack) and a well-head. Screens or water inlet sections are inserted where the well passes through sections of the water-bearing rock (typically gravel, sand or fissured limestone), or all the way up the well lining if water-bearing rocks are present throughout the depth of the well.

Here are some important principles to remember when designing the well:

- Ensure the well shaft cannot collapse, and the well-head will not break.
- Wells safely dug during the dry season may become unstable when the water level rises in the wet season. In such circumstances the well must be lined to prevent a collapse.
- It is very important to design the well so that dirt and pollutants on the ground surface cannot contaminate the well water. Make sure that any spaces between concrete rings, the slab and well cover are filled in with concrete. Fit the pump on a raised pedestal.
- Design the well to ensure that any water spilled from the pump drains into a soak-away pit filled with rocks and gravel some distance away from the well.
- Make sure that the well is deep enough to provide water throughout the dry season.
- Place a layer of gravel in the bottom of the well to avoid it becoming filled with silt.
- Use properly mixed concrete and reinforcement, and allow them to 'cure' to ensure long life. Curing involves protecting concrete from loss of moisture by keeping it within a reasonable temperature range for a time. Curing typically takes around one week.
- Build a manhole cover to allow continued access to the water if the pump breaks.

### Ensure good quality and safe construction.

- Make sure the well digging is overseen by an experienced person. A rota of available workers should be drawn up with the community.
- Ensure the materials are good quality so that the well won't collapse. Make sure the cement, sand and water used is clean, without silt, dirt, or salt.
- Where the ground is soft (sand and gravel, river sediments) it may be possible to hand-drill a well, rather than hand-dig it. Hand-drilled wells are quicker to sink, use less materials, and are usually better protected from contamination. Hand drilling equipment is needed, and the work should be managed by somebody with experience in drilling.

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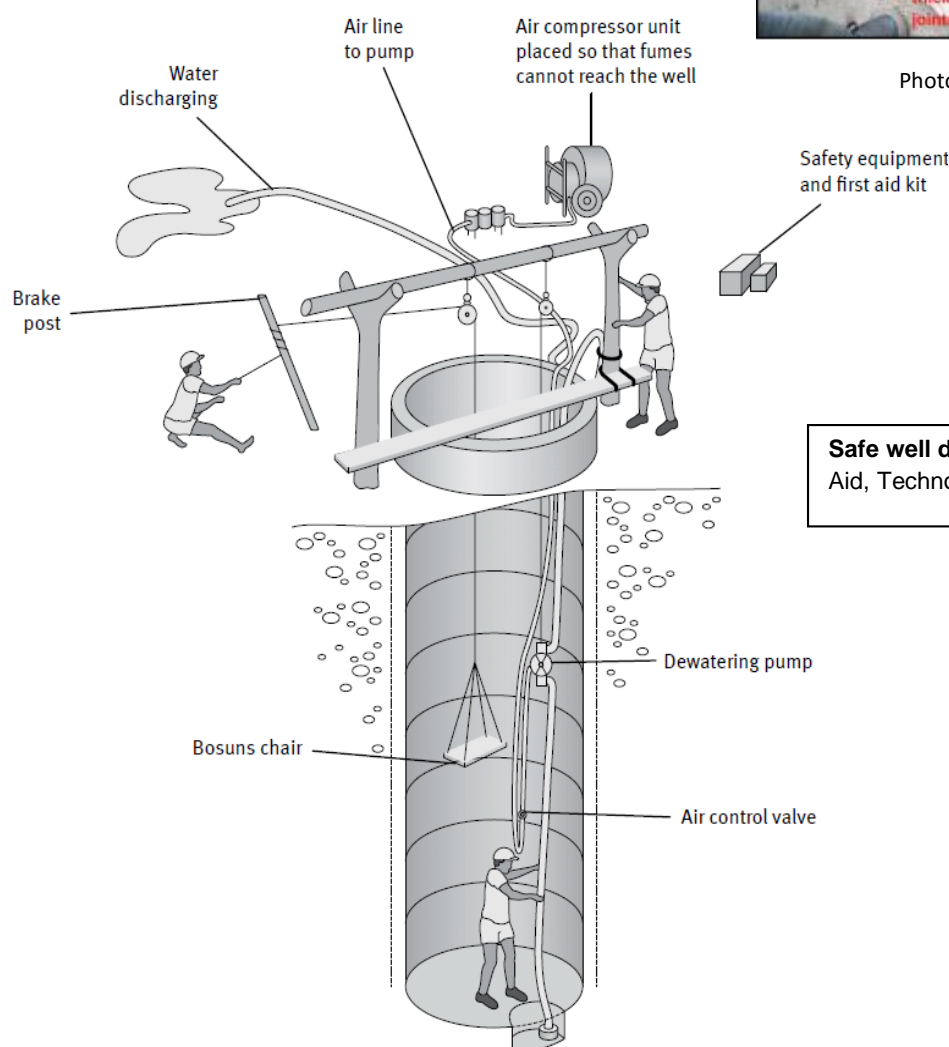
- Make sure the flow of water from the well does not reduce or stop. It is best to dig the well in the dry season. Can you test the flow before starting? How can you ensure that not too much water is taken from the well, so that the water level always recovers? Will the well be deep enough?

There are several ways to supporting the well sides while digging. The safest way is to dig within pre-cast concrete rings which lower in to the ground as you dig and become the permanent well lining. The first ring has a 'cutting edge', and more rings are placed on it as the hole gets deeper. As the hole is dug within the ring, the ring sinks into the ground. This approach should always be used in unstable ground – such as loose gravel or sand. When the well has been dug to its full depth, the joints between the rings that are above the water table should be sealed with a cement mortar.

This well lining is poorly constructed. The concrete rings are badly formed. A new mould is needed to cast any more rings. The red arrows show that the joints need sealing between rings to prevent dirty surface water getting into the well.



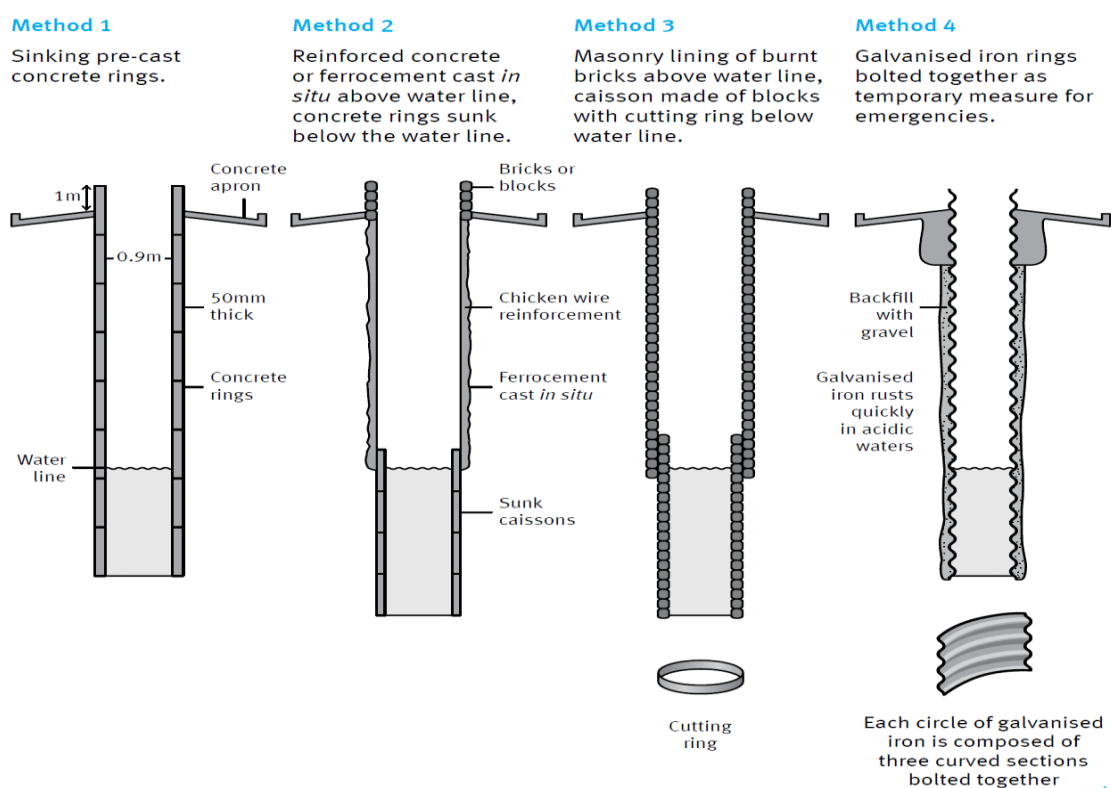
Photo: Frank Greaves/Tearfund



**Safe well digging.** Diagram from Water Aid, Technology Notes, 2013

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In firm and stable ground, wells may be safely dug without support, although permanent supporting lining will stop the sides from collapsing and prevent pollution by surface water. Suitable lining materials are shown in the following drawings and include concrete, precast concrete, masonry and brickwork.



Different ways of lining a well. - Diagram from Water Aid, Technology Notes, 2013

### Carry out water quality testing, commissioning and handover.

Before the well can be used, it has to be cleaned and tested. This is called commissioning. You may have to pay the local authority to test, approve and certify the well. After the handpump is installed, disinfect the well with chlorine before use.

**Handover** - ensure there is clear ownership and responsibility for maintenance. This should be written down and kept in an agreed place such as in a local authority office.

Encourage the community to develop a Water Safety Plan to keep water free from contamination and plan for ongoing well maintenance. See **Tool C2: Water safety plans** for more information.

### Ensure ongoing maintenance and testing.

It is usual to employ or train someone or a group of people to maintain and regularly test the well. This may be the water or public health technical officer from the local authority, or a local person certified by them.

- It is important that they keep checking the well to make sure the pump does not break.
- Find or set up a supplier of spare parts so you can fix the pump if it breaks.
- Ensure the pump is regularly greased, and that seals are replaced and nuts tightened.
- It is good practice to change the foot-valve and piston seal once a year.
- Train the local community to use the pump correctly. You may want to train children so they know that playing on it can break it. How can you prevent the pump from being broken on purpose? How can you discourage people from throwing things into the well?

### Keep the water free from contamination.

- The water shouldn't become cloudy, salty or contaminated with faeces, chemicals or harmful compounds (eg fluoride, iron, arsenic).
- If the water tastes or smells bad there could be chemicals in the well water. Get it tested. Chemical contamination is extremely difficult to fix: it is better to consider alternative well locations.
- How can animals and people be stopped from defecating near the well?
- Ensure that surface drained water does not pass close to, or stand near to, the well.
- Ensure latrines are never constructed nearby or up-slope from the well.
- The well-head should not become covered with flood water. If the area is prone to flooding, can the well be built somewhere else? Or can the well-head be built above maximum flood levels?



### Finding out more

- WaterAid Technical Brief (2013) *Hand-dug wells* [wateraid.org/technologies](http://wateraid.org/technologies)
- WaterAid Technical Brief (2013) *Handpumps* [wateraid.org/~media/Publications/Handpumps.pdf](http://wateraid.org/~media/Publications/Handpumps.pdf)
- SB Watt & WE Wells (1979) *Hand-dug wells and their construction*, Practical Action Publishing
- Loughborough University (1994) *Simple drilling methods* [lboro.ac.uk/well/resources/technical-briefs/43-simple-drilling-methods.pdf](http://lboro.ac.uk/well/resources/technical-briefs/43-simple-drilling-methods.pdf)
- Loughborough University (1994) *Introduction to hand dug and drilled wells* [rural-water-supply.net/en/implementation/manual-drilling/177-an-introduction-to-hand-dug-and-drilled-wells](http://rural-water-supply.net/en/implementation/manual-drilling/177-an-introduction-to-hand-dug-and-drilled-wells)

#### Related tools:

- B – Water for blessing (Bible study) [*B: Water, sanitation & hygiene-3*]
- B – Water for life (Bible study) [*B: Water, sanitation & hygiene-4*]
- C2 – Rainwater harvesting [*C2: Water, sanitation & hygiene-1*]
- C2 – Protecting a spring (a water source) [*C2: Water, sanitation & hygiene-2*]
- C2 – Community involvement in siting and constructing boreholes [*C2: Water, sanitation & hygiene-5*]



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